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ABSTRACT

The purpose of this research was to use a Tennessee high school as a research site to assess the impact of H. Gardner's Multiple Intelligences (MI) on students' academic successes in 10th grade English, social studies, mathematics, and science classes. The research used a two-part minimally intrusive data collection protocol. The student population of the high school's 10th grade was stratified into two academic groups: honors and regular. From these 2 populations, 60 students from each group were assigned to the research participation database. Each student was surveyed to determine the multiple intelligence that they had used in English, social studies, mathematics, and science classes. This process required each student to complete the Student Multiple Assessment Reporting Test four times, completing each survey in approximately 10 minutes and the entire process in 40 minutes. Students' semester, first quarter, and second quarter grades were collected. Stepwise multiple regression with hierarchical clustering was used to determine the typologies of successful and unsuccessful students in these core subjects. There were significant differences between successful and unsuccessful students in all subject areas. Overall, however, the theory of multiple intelligence was found to be unproductive in the areas of student metacognitive activities and awareness as well as in the areas of student academic success. Under the MI theory, the more successful student should have had a significantly different typology of metacognitive awareness and activities across all subject areas from that of the unsuccessful student. The typologies were significantly different, but the typologies themselves were not the same across differing subject areas. One appendix lists metacognitive factors and regression equations, and the other contains subject times factor graphs. (Contains 5 graphs and 36 references.) (SLD)

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The Typologies of Successful and Unsuccessful Students in the Core Subjects of Language Arts, Mathematics, Science, and Social Studies using the Theory of Multiple Intelligences in a High School Environment in Tennessee

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Abstract

The purpose of this research was to use XXXX High School as a research site to assess the impact of Gardner's Multiple Intelligences (MI) on students' academic successes in 10th grade English, Social Studies, Mathematics, and Science classes. This research used a two-part minimally intrusive data collection protocol. The student population of XXX's 10th grade was stratified into two academic groups, (1) Honors group and (2) Regular group. From these two populations 60 students to from each research group was randomly assigned to the research participation database. This resulted in 60 randomly assigned students in the Honors research group and 60 students in the Regular research group. Each student was surveyed to ascertain which multiple intelligence(s) they have used in English, Social Studies, Mathematics, and Science classes. This required each student to complete the survey instrument, Student Multiple Assessment Reporting Test (SMART) four times. Each survey was completed in approximately ten (10) minutes. The entire data collection process was completed in forty (40) minutes. Students' semester, 1st quarter, and 2nd quarter grades were collected. Step-wise multiple regression with hierarchical clustering was used to determine the typologies of successful and unsuccessful students in the core subjects of Language Arts, Mathematics, Science, and Social Studies. There were significant differences between successful and unsuccessful students in all subject areas.

Importance of the Study

MI theory as postulated by Gardner (1983) states that every individual has different kinds of intelligences that they are born with and cannot change. The seven different intelligences identified by Gardner are, linguistic, logical-mathematical, musical, spatial, bodily kinesthetic, interpersonal and intrapersonal. Many teachers accept MI theory and are attempting to teach students in the manner that will enhance their dominant intelligence(s). If these (MI) intelligences are not being used by students to increase their learning rate, then teachers' actions trying to incorporate the seven multiple intelligences to enhance student learning will be futile. But if we can ascertain student meta-cognitive learning actions we as educators can maximize student learning outcomes.

Brief Literature Review

Since MI's inception in 1983, the theory has not meet serious challenge. Gardner's theory of MI has rapidly been incorporated into school curriculum since it's inception in 1983. It has swept the educational system across the United States like a grassroots movement. According to Gardner and the proposed seven human intelligences, we are all able to know the world through 1) language, 2) musical thinking, 3) logical-mathematical analysis, 4) spatial representation, 5) use of body to solve problems, 6) an understanding of other individuals, and 7) an understanding of ourselves. Individuals differ in the way the intelligences are invoked and combined to carry out different tasks, solve diverse problems, and programs in various domains (Gardner, 1991). According to Gardner there are at least seven different intelligences and he says that there are no two people who have the same intelligence profile. Gardner's central idea is that MI is a psychological theory of the mind. It's a refutation of the idea that there is a single intelligence humans are born with, which can't be changed and which psychologists can measure (Weiss, 1999).

Gardner suggests teaching/learning methods schools could use to assist students to better understand and process information. He also supports authentic assessments to further increase teachers' understandings of their students' learning processes and outcomes. Pedagogical actions such as: 1) learning from suggestive institutions such as apprenticeship, science museums etc., 2) a framework that facilitates understanding, and 3) multiple entry points of understanding are recommended by Gardner (1999). But these methods and manners of assessment are not predicated on Gardner's MI but upon basic constructivist learning theory. Also as constructivism and perceptual theory states the dominant factor will be what the student perceived to be occurring in the classroom, not what the teachers' perception of what the student has perceived in the classroom. The best data source is the person closest to the event, in this case students' perceptions of their meta-cognitive learning actions/cognitions.

Intervention through the use of cooperative learning and employment of the theory of multiple intelligences indicate an increase in students' responsibility for their own learning through an increase in academic output and a decrease in the incidents of inappropriate behavior (Erb, 1996). This is a case of multiple variables; the research doesn't delineate between cooperative learning effects and the effect of using MI theory. In the face of increasing cultural diversity, educators need new ways of understanding how children think. The theory of multiple intelligences provides a means for distinguishing the many ways children solve problems and create products, identify cognitive strengths, and group students according to complementary intelligences (Gray, Viens, 1994). Again the results will be effected by the data source, were students asked? Or were teachers asked about their students?

Allowing students to use their knowledge about how they learn best can increase their enthusiasm, raise achievement levels and develop their other intelligences (Sweet,

1998). Zurakowski (1993) conducted a study, which developed and applied Rasch methodology and factor analysis to the analysis of intelligence to data. In order to do this, a way to make the quality of the intelligence visible must be developed, and observations were then taken into well-defined psychological variables along which objective measurements can be made. Psychometric methodology was used to transform observations into measures. His results were connected to several theories Gardner's multiple intelligence theory being one of them. Results were connected to these theories to propose a theory of MI, the structure of which contains six distinct kind of human abilities (Zurakowski, 1993).

A literature survey on MI, revealed that the use of Gardner's Theory in school serve to heighten student progress in an indirect way. It serves to heighten the awareness of student needs in many different types of classroom settings (Gisher, 1997). Sternberg, (1994) as put by Bouton (1997) asserts that although the theory is based on empirical findings, there is surprisingly little evidence of efforts to validate MI theory over the decade since its inception. Sternberg further states, the issue of educational reform needs to focus on the whole child rather than on a continuum of hypothetical structures of abilities. While producing quality musicians and athletes is important, Sternberg argues that emphasis in academe should be on strengthening those traditional academic abilities in which our students are weak.

Levin (1994) takes issue with Gardner's (1993) commentary on the first 'MI school' the Key School in Indianapolis. Little attention is given to the process of implementing MI theory. For example, the reader is not told what motivated teachers to undertake such an ambitious project, what strategy was followed to create the school, or impact on student demographics or enrollment. What was the impact of MI training on school staffs? Is curriculum and pedagogy profoundly transformed or is a new tool added to existing practices? A study to determine if a relationship exits between

teaching to Gardner's Theory of Multiple Intelligence and fourth graders' self esteem was conducted. This study indicated that Gardner's Theory of Multiple Intelligences may be one viable instruction strategy for teachers in the struggle to enhance student self-esteem (Rosenthal, 1998).

Gardener's theory of multiple intelligence ignores certain assumptions about the nature, display, and development of intelligence. Instead of determining how many intelligences a child displays, educators must observe the kinds of activities and roles in which the child shows strength. Teachers should organize curricula around the child, not the intelligence, and look for specialized strengths without attaching labels (Hatch, 1997). Evidence for the predictive value of Gardner's MI theory is weak, and there isn't a body of research showing that its practical applications have been effective. No one as asserted that MI theory and practices are negatively associated with student learning outcomes, but the danger is that it leads to wasted time, to an emphasis on less important skills and to a false sense that learning has taken place when it has not.

Gardner in his book Frames of Mind warns that his work needs to be amply discussed and tested. Gardner's intelligences do not seem to be independent faculties, while other intelligences divide up into more than one faculty as is believed by many neurologist and psychologists. There may be less to the theory of MI than many educators seem to believe (Collins, 1998).

Research Questions:

The questions investigated in this study were:

1) Can MI be shown to exist via factor analysis?
2) What are the MI typology of the very successful, successful, unsuccessful and very unsuccessful students. [Note: The very successful student scored at or above the 95th percentile. The successful student scored between the 90th and 95th

percentiles. The unsuccessful student scored between the 10th and 5th percentiles and the very unsuccessful student scored below the 5th percentile.]

Hypothesis

1) There is not significant difference between students multiple intelligence scores in relationship to the students' academic success levels as measured by semester numeric grades.

Methodology

After permission to conduct a research study at XXXX High School was granted, all the 10th grade Honors and Regular Students were identified. 60 students were randomly selected from each group. Consent forms were mailed home to each parent/guardian of all identified research participants. Attached to the consent form were two letters, 1) a letter explaining the research purpose in layperson's terminology, and 2) a letter of support from the principal. 41 students agreed to participate, a 34% acceptance rate. The 41 respondents demographics were, 90% European-American, 5% African-American and 5% Asian American. Genders were equally represented. There were 19 regular students and 21 honors students. Data were collected on November 2nd, 1999. Initial data analysis (factor & class level) occurred in December. Two weeks after the end of the 1st semester, participating students' numerical semester grades in English, Social Studies, Mathematics, and Science will be collected. A second data analysis (factors & grades) was conducted.

Instrument

The data collection instrument SMART (Student MI Assessment Reporting Instrument) was developed and used. Four surveys were conducted in Social Studies, Mathematics, Language Arts, and Science classes. There were a total of 28 item statements, with 4 item statements per multiple.

Each intelligence was defined by the use of key words, which are descriptors of the variables that scale assesses. The logic-mathematical scale was composed of the following descriptors, problem solving, reason, understand the relationship between concepts, organize. The spatial scale was composed of the following descriptors, recognize relationships between objects, represent something graphical, use imagination, and manipulate images. The language scale was composed of the following descriptors, listen, write, remember information, and explain. The musical scale was composed of the following descriptors, be aware of environmental sounds, think in sounds, rhythms, and patterns, response to tones, and sing or hum. The intrapersonal scale was composed of the following descriptors, evaluate my own thinking, be reflective and analytical, control myself, recognize my strengths and weakness. The interpersonal scale has the following descriptors, cooperate with others, understand people's feelings and points of view, organize, sense others' motivation.

All the item statements were measured using a 5-point (0-completely disagree; 1-partially disagree; 2-neither agree nor disagree; 3-partially agree; 4-completely agree). The factor scores were generated by add the items' scores and dividing by 16. This produced a ratio score for each proposed factor ranging from 0.00 to 1.00. The ratio scores were then multiplied by 100 to create a100-point scale. The resulted in a scale of 0 – 100 where 0 means never used and 100 means always used. This scale was used because it is the most recognized scale in the education profession and noneducational professions.

Validity and Reliability

Validity of the instrument was ascertained using inter-rater coefficients. The three researchers agreed on item placement with the seven factors at the 96% level. Eleven doctoral students, all of whom were teachers, were also used. Their inter-rater coefficient was 92%. This established the validity of the instrument from the educator's

perspective. Factor analysis was used to ascertain validity from students' perspectives. Each of the resultant factors were found to have Cronbach Alpha coefficients of .70 or higher.

Procedure

All the students completed the instruments in a 40 minute time frame in the school auditorium. The researcher and his associates conducted the survey. The students were informed that their answers would not affect their grades and that their teachers would not have access to the data. Students' perceptions were revealed by their answers to the item statements. The students answered the item statement for each of the four academic subjects under study.

Data Analysis

The data were analyzed using 1) Factor analysis, and 2) multiple regression. Factor analysis was used to ascertain validity of the SMART from students' perspectives. Multiple regression was used to ascertain the partial etas or effect size of the students' perspectives as measured by the SMART on student academic success.

Statistical Analysis

The statistical analysis of the data revealed five factors for each subject Math, English, Science, and Social studies. Gardner's MI theory predicted that the factors for the four core subjects would be the same. This assertion is not supported by the data. Therefore research question one is answered in the negative. Research question two and hypothesis 1 are not testable because Gardner's multiple intelligences were not found to exist from the perceptions of students. Student data factored into five different factors in each of the main subjects. Items clustered on different factors depending on which subject area students were responding to.

Multiple regression analyses revealed that each subject area was influenced by different students' perceptions of their metacognitive awareness and activities (See Appendix A for item statements of factors).

MR Equations

Student grade (Social studies semester) = .352(R-C) + (-293)(S-C) + error (1)

Student grade (Language Arts semester) = .590(P-I) + (-.430)(A-C) + .361(Empathy) + (-.240)(C-C) + (-.285)(Meta-C) + error (2)

Student grade (Math semester) = -.442(A-C) + .367(P-I) + .347(A-C) + .349(C-C) + (-.299)(Meta-C) + error (3)

Student grade (Science semester) = .257(A-C) + (-.354)(non-reactive) + .366(C-C) + error (4)

Results

The first research question, 'Can MI be shown to exist via factor analysis?', was predicated on the assumption that Gardner's MI theory would be predictive of students' perceptions of their cognitions in their classrooms. The above results led to the rejection of Gardner's multiple intelligences as perceived by the students. While there were patterns of students' metacognition, these patterns were not stable across classroom subjects. Because the first research question was rejected, the second research question and hypothesis 1 became untestable. These data results necessitated the development of a new research question and hypotheses.

Revised Research Question

New research question #1: Are students' meta-cognitive awareness of their learning actions predictors of their grades?

Revised Hypotheses

H_1 –Students' metacognitive awareness is not a significant predictor of their grades in science, mathematics, language arts, and social studies classes.

The above statistical analyses led to the acceptance of the research question. Hypothesis 1 was rejected because statistical analyses reviewed that students' metacognitive awareness and activities were significantly related to student learning outcomes.

Discussion

This literature review related to this research indicates that Gardner's MI theory is well supported by the teaching profession and collegiate professorate. Numerous interviews and personal communications also indicate that educators accept and use MI theory in their classrooms. But, students' metacognitive activities and awareness patterns were not predicted by MI theory, nor do those patterns factor in a manner that would lend support to MI theory. There is a clear disconnection between what the teachers think is occurring in the classrooms and what their students think they are doing, thinking in the classroom. Since students' perceptions of their metacognitive activities and awareness was not predicted by Gardner's theoretical construct this places that construct under suspicion.

As pervious research as shown students' perceptions of the learning environment are predictive of student learning outcomes (see Bennett, (1976); Brekelmans, (1989); Brekelmans, Holvast, & van Tartwijk (1992); Brekelmans, Levy, & Rodriguez (1993); Brekelmans, Wubbels, & and Creton (1990); Creton, Wubbels, & Hooymayers (1993); Fisher (1995); Fraser (1986); Henderson, Fisher, & Fraser (1995, April); Tuckman (1970); Wubbels, Brekelmans, Creton, & Hooymayers (1989);Wubbels, Creton, Levy, & Hooymayers (1993). Therefore, the assertion that students do have preferential methods of learning and achieving in a formal school is supported.

Successful students have a series of actions in common. But, in contradiction to an assumption of Gardner's MI theory, these metacognitive actions and activities are not stable across subject areas. The typology of the successful student significantly changes from subject to subject, but there are overlapping areas of common metacognitive activity/awareness.

Successful students have series of actions in common, they are metacognitive in nature. Gardner's MI theory predicted that multiple intelligences would be rather stable across subject. This research failed to support that assertion. Also, the found meta-cognitive actions and activities were not stable across subject areas. The typology of the successful student significantly changes from subject to subject, but there are overlapping areas of common meta-cognitive activity awareness. Such as, language factor 4 – physical interaction, language factor 1 – active cognition (reason, think, remember, explain), socfac2 negatively impacted the grades.

Language Arts

Multiple regression analysis resulted in an equation that predicted 44% of students' language arts grades. Student grade (Language Arts semester) = 590(P-I) + (-.430)(A-C) + .361(Empathy) + (-.240)(C-C) + (-.285)(Meta-C) + error. The factors indicated that the successful students act in the following ways in order to achieve success: physical interaction- they move around, cooperate with others, manipulate images; Empathetic - they use their imagination, organize, understand people's feelings and points of view, sense others motivations and write. The successful student seems to mimic the subject area teacher's preferred teaching style. Although the use of active cognition (reason think, remember, explain), cognitive construction (whole body awarness, organize) and meta-cognitivism (recognize and understand relationships and their strengths and weakness, evaluate their thinking) negatively affects student grades,

as soon as they adjust such behavior in language arts they do well as can be seen on the graph. It seems that when they try to take control of their learning, by reasoning, try to understand concepts they earn lower grades. They actively resist the teacher's preferred learning style. They do not act in the manner that the teacher seems to desire. They use their own style of learning. Thus they get lower grades when they use active cognition, cognitive construction, and meta-cognitivism. Students get low grades possibly because they do not use teacher's preferred style of doing their work. Teachers have styles that they have a tendency to use and expect students to use. A teacher's teaching style if does not match a student's style or way of learning, grades will therefore be affected.

Math

Multiple regression analysis resulted in an equation that predicted 50% of student Math grades. Student grade (math semester) = -.442(Active-cognition) + .367(Physical-inteeraction) + .347(Active-constructive) + .349(Cognitive-construct) + (-.299)(Metacognitive) + error. In Math students act in the following ways in order to achieve success: physically interact with the environment and their fellow students– highly social and emotional, active constructive - they think and remember information; and cognitive construction - they control themselves, solve problems, and organize. On the other hand when they use active cognition (negative) - use their mind, they think, reason, remember, sing or hum explain, and meta-cognitivism – recognize relationships, understand relationships between concepts evaluate thinking and recognize strengths and weakness they do not do very well.

Here again active cognition, and meta-cognitivism indicates a decrease in grades. Whenever they adjust to the teachers preferred teaching style and do not reason, do not try to understand concepts etc. they earn higher academic scores. The

unsuccessful students do not do any of the above thus they do not do well in Math and language arts. Two factors negatively affected math grades that is the use of active cognition and meta-cognition. Whenever the students are reflective and analytical, think reason, remember information, recognize and understand relationships, sing, and hum they receive lower grades in math. Therefore it is evident that if a student is compliant to the teacher's wishes in the way they think and do things in the classroom they do well be rewarded with higher academic scores. The successful students are aware of what they do. While the unsuccessful students probably are not flexible in the ways they learn. Another interesting result of this study is the fact that successful students reflect the characteristics of a good teacher. They mimic the behavior of the teacher. I propose that things, such as the use of language, vocabulary etc. if reflective of teachers actions and behaviors is related to higher student grades. It is an indication that they are following the teachers actions and acknowledging the teacher's preferred teaching styles, behaviors and communications. An example of the negative impact of this type of power relationship is the gifted program. In many gifted programs the teacher is instrumental in determining who entered the program. There are many student out there who are very qualified or maybe better qualified to join the program but because their teachers feel that the students do not have the characteristics of the best learner they are not allowed into the program.

The unsuccessful students do not reflect the characteristics of the teacher. They use their own learning style. For example, they learning style and strategies they use in language would be the same they use for math, yet to be successful apart from other factors one has to be flexible i.e. change way of learning in each class to achieve better grades. There is also the need to reflect teacher's expectations and preferred learning style, which the unsuccessful student does not buy into. I suggest that this could possibly go into organization of work. Remember there are evaluations that are

subjective. If work is not organized in the manner that the teacher expected grades would be affected. The unsuccessful students do not reflect the characteristics of the teacher.

Successful students have series of actions in common. Though these meta-cognitive actions and activities are not stable across subject areas. The typology of the successful student significantly changes from subject to subject, but there are overlapping areas of common meta-cognitive activity awareness.

Science

Actively Constructive

Student grade (Science semester) = .257(A-C) + (-.354)(non-reactive) + .366(C-C) + error. Successful science students were active constructors involved in the learning process. They reason to increase their learning rate. They reason, think conceptually, they are reflective and analytical, and they remember information to increase their learning rate. However, unsuccessful students are not active constructors. They are incapable or refuse to shift their learning skills to suit and match that of their teachers. They are not actively involved in the learning process, they do not reason, think conceptually, reflect and analyze, organize, or understand relationships between concepts in science.

Non-reactive

Successful science students were not reactive or inattentive to any distracting factor. They block out the environmental sounds to increase their learning rate. They do not response to tones nor sing or hum during the learning process, and they don't move around in class. On the contrary, unsuccessful students are reactive or attentive. They easily react and attend to environmental sounds, they response to tones, sing and hum during the learning process.

Cognitively-constructive

Successful science students are cognitively constructively engaged in the learning process. They solve problems, remember information, organize, represent something graphically, and understand the relationship between concepts to increase their learning rate. Unsuccessful students are not cognitive constructive in learning science. They are poor at solving problems, remembering information, organizing, representing something graphically, and understanding the relationship between concepts

Social Studies

Reflective-Constructive

Student grade (Social studies semester) = .352(R-C) + (-293)(S-C) + error. Successful social studies students are reflective constructive students. They move around, cooperate with others, manipulate images, response to tones, express themselves through movement, and think in sounds rhythms, and patterns to increase their learning rate. Unsuccessful students do not cooperate with others and they do not express themselves or communicate clearly with their teachers.

Social-Constructive

Successful social studies students are not social constructive. Students do not think conceptually, they are neither reflective nor analytical, they do not reason nor remember information to increase their learning rate. However, they are apparently aware of the teacher's version of the social environment of their class. They seem to mimic their teachers' preferred ways of teaching and learning. They do not cooperate with others. However, unsuccessful students are social constructive. They are aware of the social environment of their class. They think conceptually, they are reflective and analytical, they reason, and remember information to increase their learning rate. Their way of learning does not match with that which is expected by their teachers.

Summary

The traditional instructivist approaches in teaching *science & social studies* and the uneven structure of power between teachers and students fails to help the very unsuccessful students and the unsuccessful students. In addition, the instructivist approach, with its emphasis on the transmission of standardized interpretations of the world and standardized assessments to match the degree of student understanding to accepted interpretations, shows a lack of concern for the learner. As Apple does in Ideology and Curriculum (1990) and Official Knowledge: Democratic Education in a Conservative Age (1993)-the cultural loss, or negation of identity, a constructivist approach with the use of cognitive tools, seems to speak for a democratic classroom, one that includes an honest acceptance of cultural difference- not as a stated curricular goal, padded away on a dusty shelf, but as an active part of day to day experience formation. In a milieu such as this, student empowerment is not assumed. It is unavoidable given the circumstance of student- generated task formation, the acquisition of information and the development of knowledge. In constructivist learning environments, dialogue--both student-to-student and student-to-teacher--is a pre-eminent instructional tool (Duffy and Cunningham, 1996; Schifter, 1996): "It is primarily through dialogue and examining different perspectives that students become knowledgeable, strategic, self-determined, and empathetic" (Tinzmann, Jones, Fennimore, Bakker, Fine, and Pierce, 1990, n.p.). Student conversation is not incidental to, but a substantial proportion, of instructional activity. This includes student talk as they work in pairs or small groups to solve problems, small- or large-group discussion of problem-solving strategies, findings, difficulties encountered, and possible alternative solutions (Brooks and Brooks, 1993). Thus Schifter (1996) describes a teacher's task as "pos[ing] questions that will lead through--rather than around--puzzlement" (p. 495). The goal of group work from a constructivist perspective "is to share alternative viewpoints

and challenge as well as help develop . . . alternative points of view" (Duffy and Cunningham, 1996, p. 187). Meyers and Jones (1993) describe the structure of active learning as being composed of elements, learning strategies, and teaching resources. The key elements are talking and listening, writing, reading, and reflecting. Students do not passively receive knowledge but must actively construct their own frameworks. Active learning strategies include small groups, cooperative work, case studies, simulations, discussion teaching, problem solving, and journal writing. Teaching resources include reading, homework assignments, outside speakers, teaching technology, and television.

Providing opportunities for extended student dialogue involves assuring that all voices are heard and respected, and that students feel safe in voicing opinions that may not be "correct" from a traditional standpoint. It is particularly important to treat errors as opportunities for learning--a different strategy than what occurs in traditional instruction. As Labinowicz (1980, quoted in Brooks and Brooks, 1993, p. 83) points out, "a child's errors are actually natural steps to understanding."

Another possibility is that Gardner's MI theory is only a descriptive theory, If this is accepted then the question must be asked what does MI theory describe. It was asserted at the AATC conference that MI theory describes how persons make sense of their world. This description is very similar to the constructivist definition of learning. That is learners organize and filter information to develop an understanding of the material under study. Therefore, if MI theory describes how people understand their world and that is congruent with learning, then MI theory is describing learning. If a theory describes learning, then that theory's descriptions can be compared to student learning outcomes. If the descriptions are reflective of reality then there should be a correlation and predictive relationship between students MI actions and students' learning outcomes. This research failed to establish that pattern. Another possibility is

that MI theory is describing how adults make sense of their world. If this is the case then MI theory should not be used in a K-12 setting. There is ample evidence the MI theory is used in the K-12 setting. Because this is so, research must be conducted to ascertain if MI theory is a productive theory in the K-12 setting. This research failed to establish the productivity of MI theory in a 10th grade setting.

In conclusion, the theory of multiple intelligences as been found to be unproductive in the areas of student metacognitive activities and awareness as well as in the area of student academic success. Under Gardner's MI theory the more successful student (i.e. 90th percentile and above) should have had a significantly different typology of metacognitive awareness and activities across all subject areas than the unsuccessful student (i.e. 10th percentile and below). The typologies were significantly different, but the typologies themselves were not the same across differing subject areas.

If students perceive that certain positive learning behaviors will help improve their grades then teaching practices should be modified so that this behavior is encouraged. Whatever the method is, as long as it leads to better grades and understanding of concepts it is worth trying. This study seems to take us back to the use of old methods such as concentrate on your work, do not look around, ignore any external factors that may distract etc. The teacher's way of teaching influences a students perception of how they learn and what they should do to improve their grade, thus the teacher's action in the classroom is central to changing students perceptions of their metacognitive activities. Teachers' actions are also central to empowering students to believe that they control their academic futures.

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Appendix A

Metacognitive Factors, and Regression Equations

Student grade (Social studies total semester) = .352(Langfac4) + (-.293)(Socfac4) + error

Mean 92.6154, Standard deviation 5.2367, Variance 27.423

Langfac4	Socfac4
Students.... (LA6) ... move around to increase their learning rate. (LA5) ... cooperate with others to increase their learning rate. (LA25)... manipulating images to increase their learning rate. (LA17). ...response to tones to increase their learning rate. (LA27) ... express themselves through movement to increase their learning rate (LA11)... represent something graphically to increase their learning rate. (LA10) ... think in sounds, rhythms, and patterns to increase their learning rate	Students.... (S23)... think conceptually to increase their learning rate. (S14) ... are reflective and analytical to increase their learning rate (S9) ... reason to increase their learning rate. (S15)... remember information to increase their learning rate.

R^2 for Langfac4 is .105, and R^2 for Socfac4 is .067.

Total variance accounted for was .172.

Student grade (Language Arts total semester) = .590(Langfac4) + (-.430)(Langfac1) + .361(Langfac3) + (-.240)(Scifac5) + (-.285)(Socfac2) + error

Mean 90.2222, Standard deviation 7.5861, Variance 57.549

Langfac4	Langfac1	Langfac3	Scifac5	Socfac2
Students.... (LA6) ... move around to increase their learning rate. (LA5) ... cooperate with others to increase their learning rate. (LA25)... manipulate images to increase their learning rate. (LA17) ...response to tones to increase their learning rate. (LA27) ... express themselves through movement to increase their learning rate (LA11)... represent something graphically to increase their learning rate. (LA10) ... think in sounds, rhythms, and patterns to increase their learning rate	Students... (LA9) .... reason to increase their learning rate. (LA23)... think conceptually to increase their learning rate. (LA15)... remember information to increase their learning rate. (LA24) ... sing or hum to increase their learning rate. (LA22)... explain to increase their learning rate	Students.... (LA18)... use imagination to increase their learning rate (LA19)... organize to increase their learning rate. (LA12)... understand peoples' feelings and points of view to increase their learning rate (LA26) ... sense others' motivations to increase their learning rate. (LA8) ... write to increase their learning rate.	Students.... (S12)... understand peoples' feelings and points of view to increase their learning rate (S22)... explain to increase their learning rate. (S13)... whole body awareness to increase their learning rate. (S19)... organize to increase their learning rate.	Students (SS4) ...recognize relationships between objects to increase their learning rate (SS16)... understand the relationship between concepts to increase their learning rate (SS11)... do {NOT} represent something graphically to increase their learning rate. (SS7) ... evaluate their own thinking to increase their learning rate (SS28) ... recognize their strengths and weaknesses to increase their learning rate

R^2 for Langfac4 is .145, R^2 for Langfac1 is .087, R^2 for Langfac3 is .074, R^2 for Scifac5 is .069, and R^2 for Socfac2 is .067.

Total variance accounted for was .442.

Student grade (Math total semester) = -.442(Langfac1) + .367(Langfac4) + .347(Scifac4) + .349(Socfac5) + (-.299)(Socfac2) + error

Mean 86.8621, Standard deviation 10.3500, Variance 107.123

Langfac1	Langfac4	Scifac4	Socfac5	Socfac2
Students... (LA9) .... reason to increase their learning rate. (LA23)... think conceptually to increase their learning rate. (LA15)... remember information to increase their learning rate. (LA24) ... sing or hum to increase their learning rate. (LA22)... explain to increase their learning rate	Students (LA6) ... move around to increase their learning rate. (LA5) ... cooperate with others to increase their learning rate. (LA25)... manipulating images to increase their learning rate. (LA17). ...response to tones to increase their learning rate. (LA27) ... express themselves through movement to increase their learning rate (LA11)... represent something graphically to increase their learning rate. (LA10) ... think in sounds, rhythms, and patterns to increase their learning rate.	Students.... (S23)... think conceptually to increase their learning rate. (S14) ... are reflective and analytical to increase their learning rate (S9) ... reason to increase their learning rate. (S15)... remember information to increase their learning rate.	Students (SS21) ...control themselves to increase their learning rate. (SS22)... explain to increase their learning rate. (SS2) .... solve problem to increase their learning rate (SS24) ... sing or hum to increase their learning rate. (SS19)... organize to increase their learning	Students (SS4) ...recognize relationships between objects to increase their learning rate (SS16)... understand the relationship between concepts to increase their learning rate (SS11)... do {NOT} represent something graphically to increase their learning rate. (SS7) ... evaluate their own thinking to increase their learning rate (SS28) ... recognize their strengths and weaknesses to increase their learning rate

R^2 for Langfac1 is .104, R^2 for Langfac4 is .176, R^2 for Scifac4 is .059, R^2 for Socfac5 is .076, and R^2 for Socfac2 is .074.

Total variance accounted for was .489.

Student grade (Science total semester) = .257(SciFac4) + (-.354)(Scifac2) + .366(Mathfac4) + error

Mean 90.2143, Standard deviation 6.3325, Variance 40.101

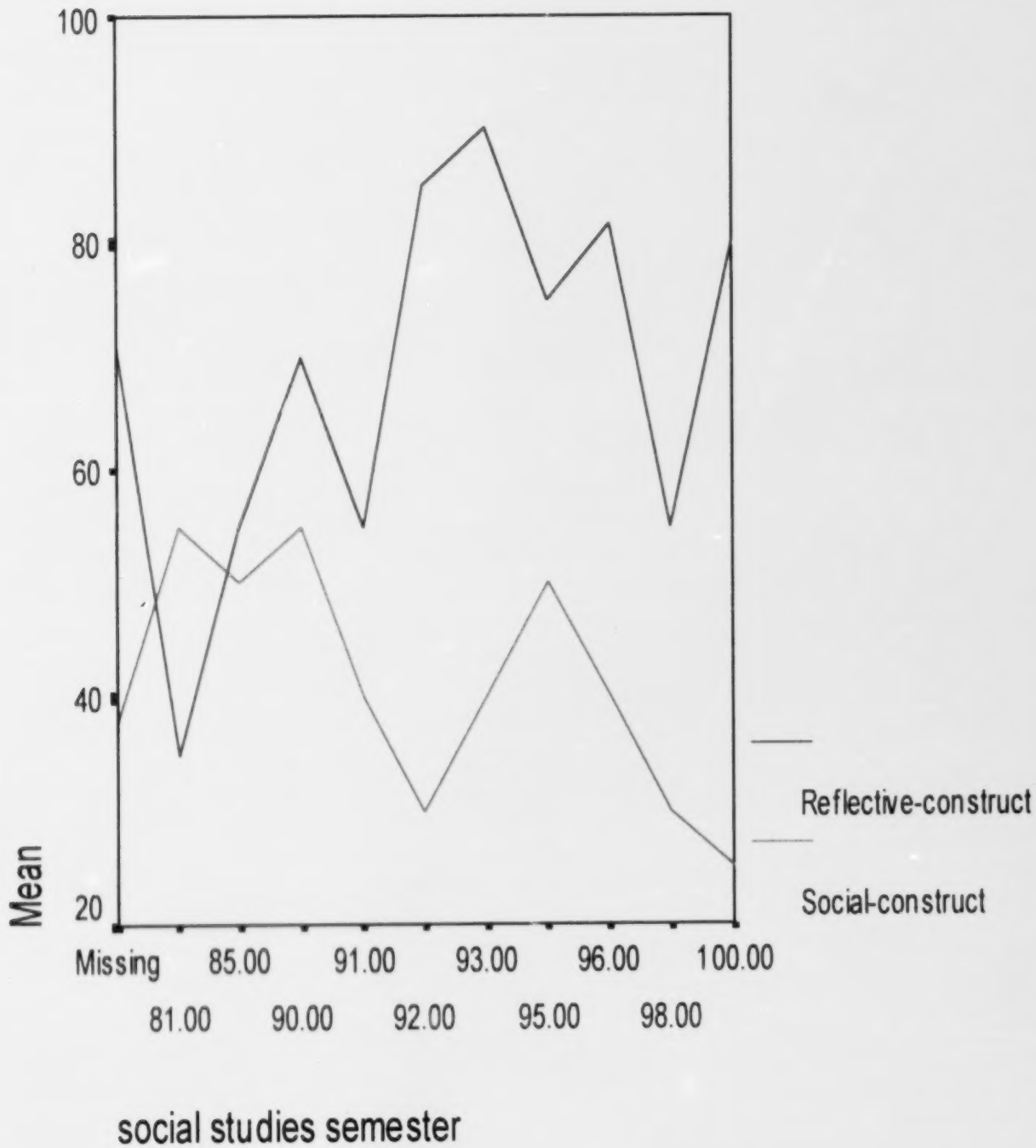
Scifac4	Scifac2	Mathfac4
Students.... (S23)... think conceptually to increase their learning rate. (S14) ... are reflective and analytical to increase their learning rate (S9) ... reason to increase their learning rate. (S15)... remember information to increase their learning rate.	Students.... (S24) ... sing or hum to increase their learning rate. (S27) ... express themselves through movement to increase their learning rate (S17). ...response to tones to increase their learning rate. (S6) ... move around to increase their learning rate. (S3) ... are aware of environmental sounds to increase their learning rate (S16)... do {NOT} understand the relationship between concepts to increase their learning rate	Students.... (MA2) .... solve problems to increase their learning rate (MA15)... remember information to increase their learning rate. (MA19)... organize to increase their learning rate. (MA11)... represent something graphically to increase their learning rate. (MA16)... understand the relationship between concepts to increase their learning rate

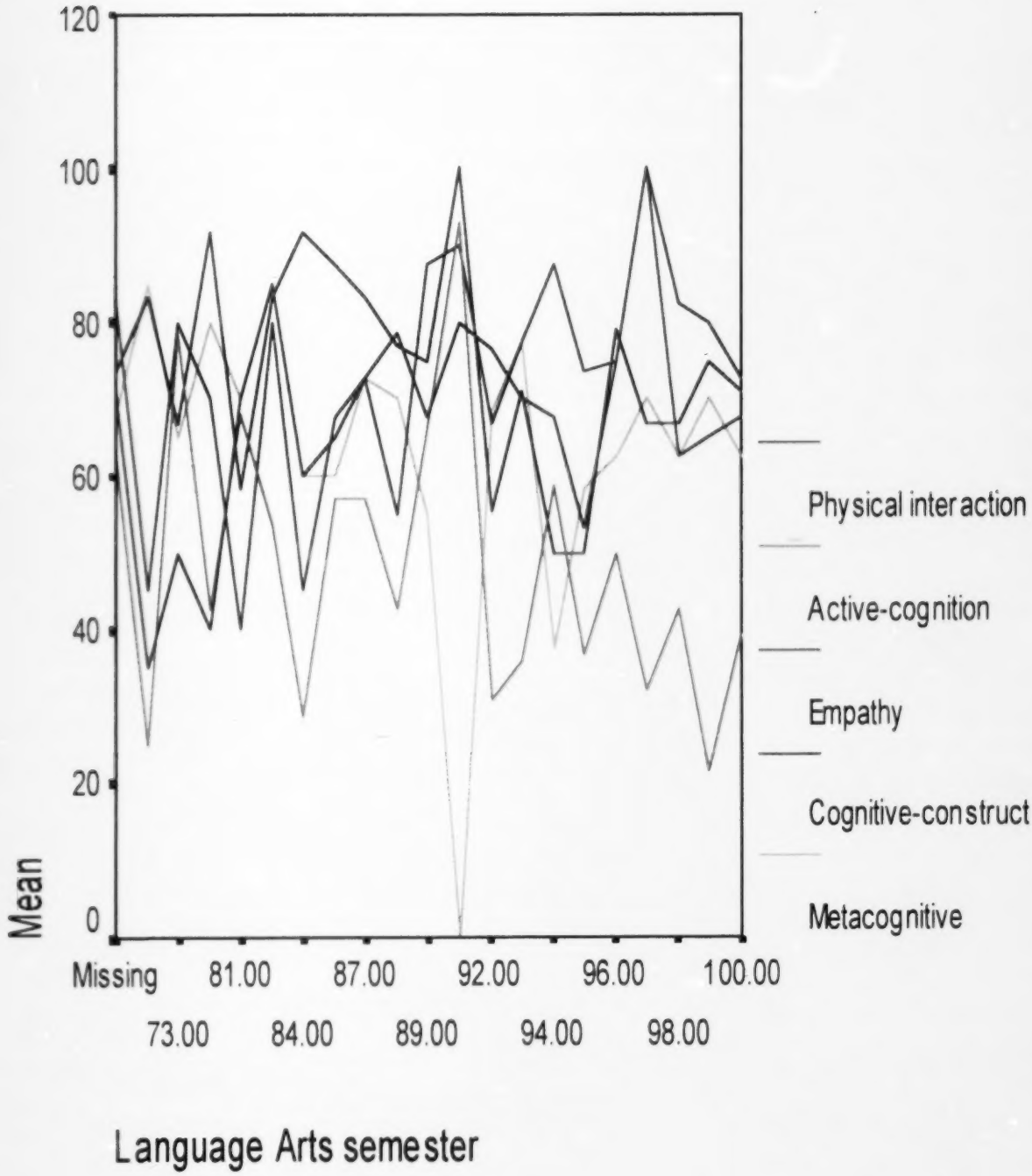
R^2 for Scifac4 is .150, R^2 for Scifac2 is .102, and R^2 for Mathfac4 is .104.

Total variance accounted for was .356.

Appendix B

Subject area X Factor graphs

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80
60
40
20
0
Mean
Missing
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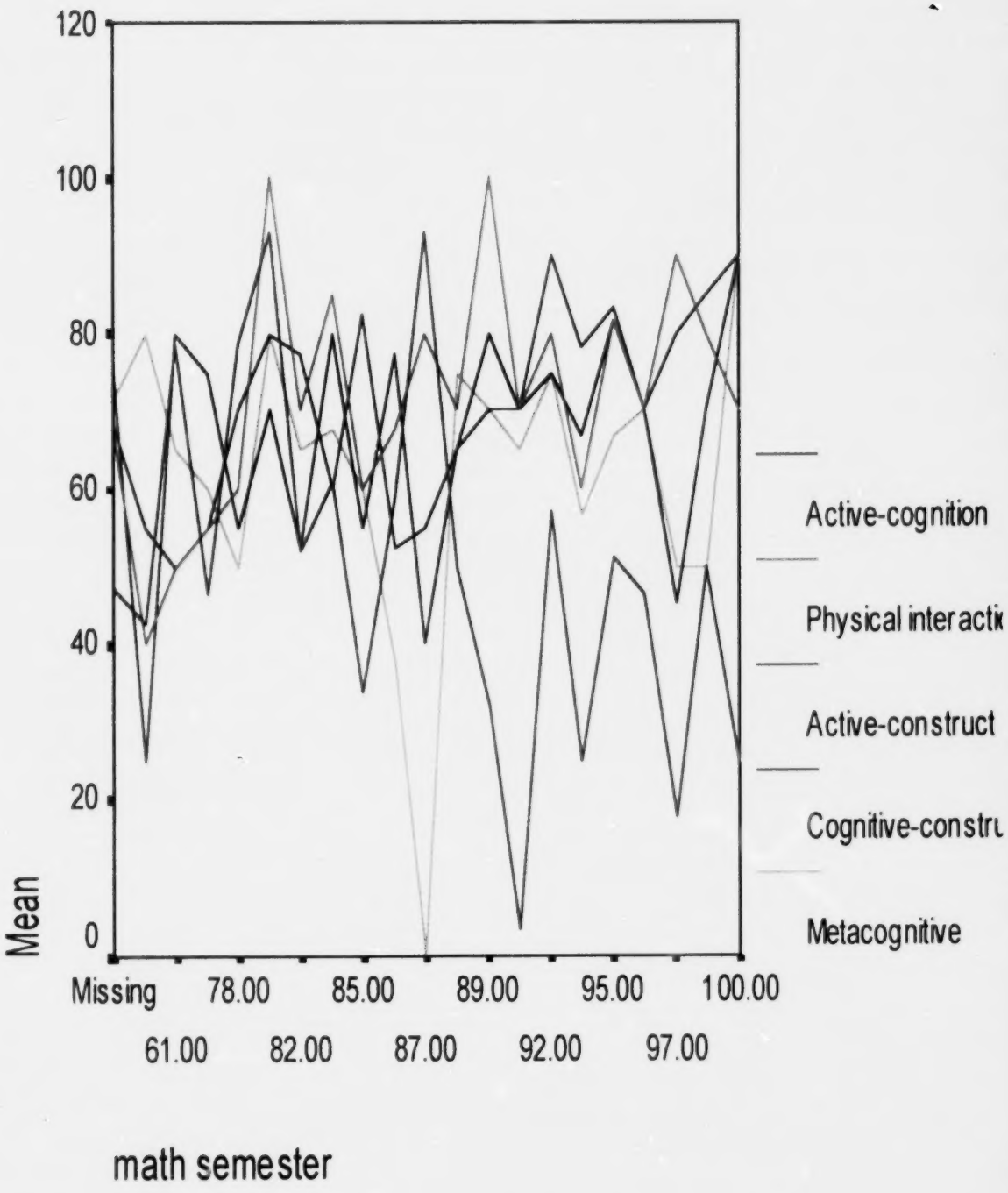
87.00
92.00
96.00
100.00
73.00
84.00
89.00
94.00
98.00
Language Arts semester
Physical interaction
Active-cognition
Empathy
Cognitive-construct
Metacognitive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Mean
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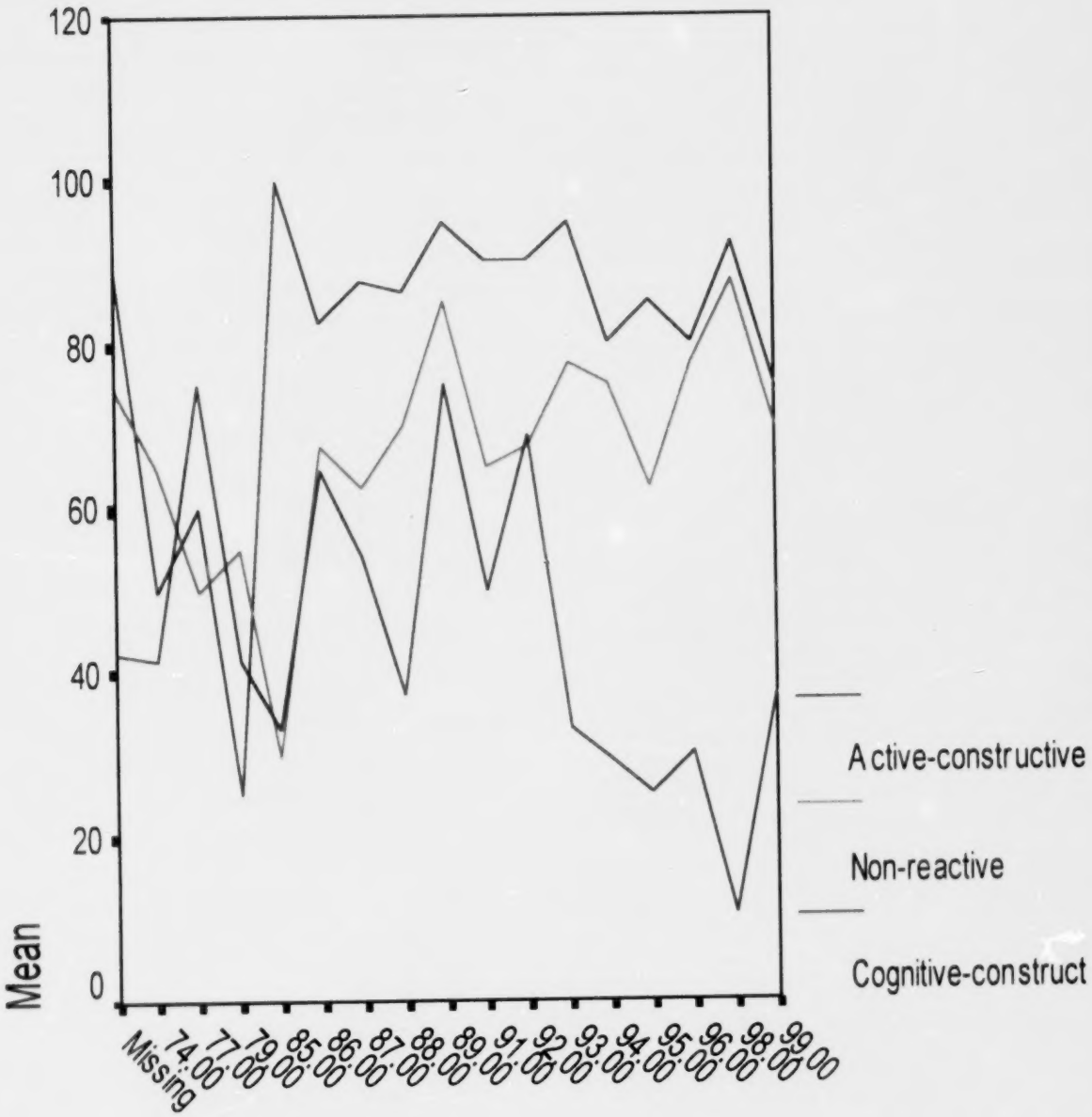
82.00
85.00
87.00
89.00
92.00
95.00
97.00
100.00
math semester
Active-cognition
Physical interacti
Active-construct
Cognitive-constru
Metacognitive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91.00
92.00
93.00
94.00
95.00
96.00
98.00
99.00
science semester grade
Active-constructive
Non-reactive
Cognitive-construct